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| 09/358,388 | 07/21/1999 | KAORI UMEZAWA | 0039-79292-2 | 1515 |

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EXAMINER

MAI, ANH D

| | |
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| ART UNIT | PAPER NUMBER |
|----------|--------------|

2814

DATE MAILED: 05/07/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/358,388

Applicant(s)

UMEZAWA ET AL.

Examiner

Anh D. Mai

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 April 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 9-11, 14-46 and 48-53 is/are pending in the application.
- 4a) Of the above claim(s) 16-22 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 9-11, 14, 15, 24-46 and 48-53 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on April 30, 2002 has been entered.

From Previous Office Action

2. The amendment filed June 13, 2001 is objected to under 35 U.S.C. 132 because it introduces new matter into the disclosure, as previously applied.

3. Claims 28, 29, 30-33 and 46 are rejected under 35 U.S.C. 112, first paragraph, for containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention, as previously applied.

4. Claims 9-11, 14, 15 and 24 are rejected under 35 U.S.C. 103(a) for being unpatentable over Rogers et al. (U.S. Patent No. 4,571,819) in view of Lee et al. (U.S. Patent No. 4,952,524), as previously applied.

5. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rogers '819 in view of Lee '524, as previously applied.

6. Claims 26 and 27 are rejected under 35 U.S.C. 103(a) for being unpatentable over Rogers '819 in view of Lee '524, as previously applied.

Art Unit: 2814

7. Claims 28 and 34 are rejected under 35 U.S.C. 103(a) for being unpatentable over Rogers '819 in view of Lee '524, as previously applied.
8. Claims 29 and 35 are rejected under 35 U.S.C. 103(a) for being unpatentable over Rogers '819 in view of Lee '524, as previously applied.
9. Claims 36-45 and 49-53 are rejected under 35 U.S.C. 103(a) for being unpatentable over Rogers '819 in view of Lee '524, as previously applied.
10. Claim 48 is rejected under 35 U.S.C. 103(a) for being unpatentable over Rogers '819 and Lee '524 as applied to claim 36 above, and further in view of Hunter et al. (U.S. Patent No. 4,631,803), as previously applied.

Specification

11. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Response to Amendment

12. The amendment filed April 30, 2002 is objected to under 35 U.S.C. 132 because it introduces new matter into the disclosure. 35 U.S.C. 132 states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows:

“each of grooves having a width narrower than 0.5μm”;

“depositing oxide film in the grooves by a CVD method using a **non doped** organic silicon source”;

“depositing oxide film **directly** on the thin thermal oxidation films”. (from the previous objection);

“wherein said oxide films are deposited or buried in the grooves so as *not to include any nitride film* in the grooves”. (from the previous objection).

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

13. Claims 9-11, 14, 15 and 24-53 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

There does not appear to be a written description of the claim limitation: “each of

✓ grooves having a width **narrower than 0.5µm**” or “depositing oxide film in the grooves by a

✓ CVD method using a **non doped** organic silicon source” or “oxide films are deposited or buried
may be means - here grant up to applicant.
in the grooves so as ***not to include any nitride film*** in the grooves” (claims 30-33 and 46) or

“depositing oxide film **directly** on the thin thermal oxidation films” (claims 28 and 29) in the application as filed.

Art Unit: 2814

✓ Although the width of $0.3\mu\text{m}$ (page 19) is less than $0.5\mu\text{m}$. However the original specification, as filed, does not explicitly support the term "**narrower than $0.5\mu\text{m}$** ".

At best, the specification disclosed: "the grooves 6 may be buried by the *silicon oxide* film in terms of CVD using, as source material, organic silicon source, silicon hydrogen compound such as SiH_4 , or silicon chloride such as SiCl_4 ". (page 19). The filed disclosure fails to specifically provide support for the newly added matter "non doped organic silicon source".

Since the limitation of claims 30-33 and 46 fails to get support from the original written specification, therefore, the rejection on merit of the claims are not warranted.

Further, the specification on page 19, line 26, clearly shows that a " Si_3N_4 film may be grown".

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

14. Claims 44 and 45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 44 recites the limitation "forming the layer of the insulating material" in lines 1-2. There is insufficient antecedent basis for this limitation in the claim.

As best understood by the examiner, the limitation of the claim should be: --wherein said depositing the layer of an insulating film comprises--.

Claim Objections

15. Claims 44 and 45 are objected to because of the following informalities: the terms “insulating material” the correct terms should be --insulating film--. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

16. Claims 9, 11, 14, 15, 24-41, 43-46, 49, 50, 51 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bose et al. (U.S. Patent No. 5,492,858) in view of Anonymous (RD 327019) (Anon ‘019).

With respect to claims 9 and 25, as best understood by the examiner, Bose teaches a method of manufacturing a semiconductor substrate having shallow trench isolation regions and device regions sandwiched by the shallow trench isolation regions substantially similar as claimed including:

(a) forming a plurality of grooves (20) on part of a surface of the semiconductor substrate (10), each of grooves having a width narrower than 0.5 μ m;

(b) depositing oxide films (14) in the grooves by a CVD method using a non doped organic silicon source;

Art Unit: 2814

(c) removing upper parts of the oxide films so as to planarize a surface of a resultant structure until surface areas of the semiconductor substrate are substantially exposed, each of the active areas of the semiconductor substrate serving as a top surface of a corresponding device region; and

(d) annealing the oxide films (14), after the removing, at a substrate temperature. (See Figs 1-5).

Thus, Bose is shown to teach all the features of the claim with the exception of annealing the oxide film at a higher temperature.

However, Anon '019 teaches annealing the oxide film at a temperature of 1150 °C but less than 1350 °C to densify and reduce stress.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to anneal the oxide film (14) of Bose at the temperature as taught by Anon '019 to densify and reduce stress.

Further, at the temperature of Bose and Anon '019, the dislocation density generated in the corresponding device region in a vicinity of the grooves is inherently less than $1 \mu\text{m}^{-2}$.

With respect to claim 11, as best understood by the examiner, the ambient during the anneal of Bose and Anon '019 includes one of the gases as claimed.

With respect to claim 14, as best understood by the examiner, trench (14) of Bose has a depth (d) to width (l) ratio as claimed.

Art Unit: 2814

With respect to claims 15 and 24, as best understood by the examiner, the arrangement of the grooves on the semiconductor substrate is clearly a design choice. The method of forming the STI is disclosed.

With respect to claims 26 and 27, as best understood by the examiner, the 4-fold or 5-fold ring structure of the oxide film is an inherent result of annealing the oxide film at high temperature as taught by Anon '019. Bose further teaches that the oxide film is annealed to densify to the degree necessary to match (substantially identical) the each rate of thermal oxide.

With respect to claims 28 and 29, as best understood by the examiner, the method of Bose further includes forming a thermal oxide film (13) on the inner walls of the grooves (20).

With respect to claims 30-33 and 46, as best understood by the examiner, the oxide film (14) of Bose is deposited in the grooves using TEOS, thus, not includes any nitride film.

With respect to claims 34 and 35, as best understood by the examiner, the thin thermal oxidation films (13) are formed by thermally oxidizing inner walls of the grooves (20).

With respect to claims 36 and 43, the method of Bose further includes forming a mask layer (11) comprises oxide on the substrate (10) wherein the mask layer exposes a part of the substrate.

With respect to claims 37 and 38, the duration of annealing of Bose is within the claimed range.

With respect to claims 39 and 40, the annealing of Anon '019 is performed in an inert atmosphere including nitrogen.

With respect to claim 41, the method of Bose further includes planarizing the insulating material (14) so that the substrate is exposed.

With respect to claim 44, as best understood by the examiner, the method of Bose further includes: forming an oxide layer (13) on inner walls of the groove (20) and depositing the insulation film (14) on the oxide layer (13) to fill the groove (20).

With respect to claim 45, the depositing the insulating film (14) of Bose comprises forming an oxide (14) by a CVD method using a non doped source.

With respect to claim 49, depositing the layer of insulating film of Bose is configured to deposit the insulating film (14) at a thickness larger than a half of a width of the groove (20).

With respect to claim 50, the forming the mask (11) of Bose is configured to provide a plurality of grooves (20) at a cross sectional view so as to define SDG region between a couple of the grooves at the cross sectional view.

With respect to claim 51, Bose teaches all of the features of the claim with the exception of explicitly disclose the width or pitch of the SDG between the couple of the grooves (20).

However, the SDG region having a width or pitch as claimed does not appears to be critical.

Therefore, given the teaching of the references, it clearly is an obvious design choice to form the SDG region having a width as claimed, since such a modification would have involved a mere change in the size of the SDG regions. A change in size is generally recognized as being within the level of ordinary skill in the art. See *In re Rose*, 105 USPQ 237 (CCPA 1955).

With respect to claim 53, each of the grooves (20) of Bose has an aspect ratio as claimed.

17. Claims 10 and 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bose and Anon '019 as applied to claims 9 and 36 above, and further in view of Rogers et al. (U.S. Patent No. 4,571,819).

Bose teaches depositing the oxide film (14) conformally in the grooves (20) by a CVD method using a non doped organic silicon source.

Thus, Bose is shown to teach all the features of the claim with the exception of explicitly disclosing a particular CVD method.

However, Rogers teaches that LPCVD is well known to deposit a conformal oxide film.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to deposit the conformal oxide film (14) of Bose using LPCVD since a layer deposit using LPCVD is known to be conformal.

With respect to claim 42, Bose planarized the insulating film (14) using REB or wet etching.

Thus, Bose is shown to teach all the features of the claim with the exception of explicitly planarizing the insulating film using chemical dry etching method.

However, Rogers teaches chemical dry etching (CDE) or wet etching can be used to planarize the insulating film.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to planarize the insulating film (14) of Bose using CDE as taught by Rogers to planarize the insulating film.

18. Claims 48 and 52 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bose and Anon '019 as applied to claim 50 above, and further in view of Applicant admitted prior art.

Art Unit: 2814

With respect to claim 48, Bose teaches etching grooves (20) using a conventional plasma etch system.

Thus, Bose is shown to teach all the features of the claim with the exception of explicitly disclosing that the grooves (20) are tapers.

However, the admitted prior art teaches that tapers groove (77) are formed in the substrate (5) to isolate the devices (98).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the grooves (20) of Bose having taper profile as taught by the admitted prior art to isolate the devices.

With respect to claim 52, the admitted prior art further teaches forming source and drain regions (91/92) in the SDG regions sandwiched by the grooves.

Response to Arguments

19. Applicant's arguments filed April 30, 2002 have been fully considered but they are not persuasive.

Contrary to Applicant assertion that claims 28-33 and 46 were objected to, these claims have never been objected to. However, these claims were rejected under 35 U.S.C. 112, first paragraph for including new matters which are not supported by the originally filed specification.

Applicant argument with respect to the specific term “depositing oxide film directly on the thin thermal oxidation film” is erroneous. The drawings do not show “oxide film 7 directly

Art Unit: 2814

on a thermal oxide layer” and the specification disclosed: “prior to deposition of the oxide film 7, a thin thermal oxidation film or Si_3N_4 may be grown” (page 19).

The term “directly” was not explicitly disclosed in the specification as filed, therefore, the matter is new.

The term not to include any nitride film in the grooves is clearly in direct conflict with the specification such as excluding a layer that might exist. Further, the absence of a layer in the drawings or written disclosure **is not a ground** to exclude any things. Therefore, the matter is new.

The specification, as filed, fails to support for depositing the oxide film neither directly on the substrate nor directly on the thermal oxidation layer.

Thus, the objection and rejection are proper.

Note that the term “buried” has never been object to or rejected. Thus, the argument with respect to “buried” is erroneous.

With respect to the argument in page 10, the argument is just that. Applicant has recognized that Rogers teaches annealing the substrate at 1000-1200°C. At this temperature, which is overlap the claimed range, the crystal defects, dislocation density, in the vicinity of the grooves is inherently relaxed or reduced to less than $1\mu\text{m}^{-2}$. Further, in view of Lee ‘524, the organic silicon based is well known to be used as the trench fill material.

Further, the said argument is amounted to against the references individually. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on

Art Unit: 2814

combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Through the lengthy argument, Applicant appears to argue about the previously cited against the new amendment, which included new set of new matter. Therefore, a response to such argument is not warranted.

20. Applicant's arguments with respect to all claims have been considered but are moot in view of the new ground(s) of rejection.


Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (703) 305-0575. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

A.M
May 3, 2002


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